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Research on active feedback control of monochromator crystal angle based on FPGA

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During the experiment, the photon flux at the Surface Diffraction Beamline (BL02U2) of the Shanghai Synchrotron Radiation Facility exhibited a gradual attenuation phenomenon, which severely impacted the progress of scientific experiments. At 8 keV, the photon flux decreased by 20% over a period of 20 hours; whereas at 19 keV, the photon flux dropped by 78% within just 20 minutes. To address this issue, a software correction technique was introduced. This technique involved reading the crystal angle encoder position every 5 minutes and comparing it with the target position. By compensating the difference to the coarse adjustment motor of the crystal angle, this method effectively alleviated the flux attenuation problem in the low-energy region. However, in the high-energy region, the photon flux still showed a sawtooth-like attenuation trend, with a 30% decrease within 24 hours. A solution based on FPGA was further adopted, which managed to keep the photon flux variation within 5% over a 24-hour period. This significantly enhanced the stability of the photon flux and thereby greatly improved experimental efficiency.

Footnotes

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